
Cooperation Model and Governance Mechanism of Industry-University-Research Based on the Reality of Chinese Education

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Abstract

Industry-university-research (“IUR”) cooperation plays an active role in enterprises, universities and research institutions in the field of education in China. But cooperation model and governance mechanism is a problem that needs to be discussed. This paper researched the cooperation model and cooperation governance mechanism in the cooperation of industry university research institute based on the perspective of knowledge governance. Through literature review and theoretical deduction, this paper obtained three cooperation models and governance mechanisms in the process of cooperation. Different cooperation models can adopt different governance mechanisms, such as loose cooperation matching relationship governance, close cooperation matching contract governance, partnership cooperation matching mixed governance. Then this paper applied the method of case study and took the Black Cyclones company as the case. The cooperation model and governance mechanism of industry-university-research cooperation of Black Cyclones company are analyzed, and the conclusion is consistent with the theoretical deduction. Thus, the paper come to the conclusion that the corresponding cooperation model and governance mechanism should be adopted in different cooperation stage and this result can provide reference for the reality of IUR in Chinese educational field.

Keywords

Industry-university-research, cooperation model, governance mechanism, case study, Chinese Education.

1. Introduction

With the arrival of the era of knowledge economy, the development of human society has entered a new stage. The field of education is no exception. All over the world is aware of the importance of knowledge innovation and starts a new round of competition with it as the core. Because of weak technological innovation ability of our enterprises in China, the former State Economic and Trade Commission put forward the construction of "industry-university-

State of the literature

The main contents of past IUR research included cooperation driving force, influencing factors, policy support, characteristics of cooperation participants, performance and measurement of IUR, etc.

The recent research theme of IURC turned from knowledge flow, influence factors to the performance, quality of cooperation process, cooperation factor matching and so on.

More and more attention has been paid to the relationship, the process of cooperation, the background of cooperation members, and how to deal with the relationship between members.

Contribution of this paper to the literature

This paper analyzed the cooperation resources input, the stability of cooperation model and the length of cooperation time according to scholars' researches and suggested one governance mechanism suitable for some kind of cooperative model.

The applicability of the cooperation model and governance mechanism is proved by case study.

The paper hoped to provide effective theoretical support for the follow-up research and reference for the reality by studying the governance mechanism of IURC.

Research ("IUR") project" Since 1992. At the beginning of 2006, Chinese government explicitly proposed to establish the technological innovation system with the enterprise as the main body, the market as the guidance and take Industry-university-research cooperation(IURC) to be the breakthrough of national innovation system construction. IURC had entered a new stage of development and education combine together with productivity since then. So far, China has been promoting IURC for more than 20 years. The establishment of effective IURC has become an important part of optimizing the national innovation system. With the help of IURC, the new entry defects can be effectively overcome so as to quickly enter the market and gain competitive advantages(Li&Gu,2013). Enterprises and universities continue to seek new ways to achieve leapfrog development for their own development needs.

IURC refers to the materialization of knowledge (corresponding industrial development), knowledge dissemination (corresponding teaching work) and knowledge discovery (corresponding research work) (Li, Wang&An, 2008). A whole process in which three aspects interact and promote each other. The basic cooperation subjects are government, social intermediary, private foundation and so on. The overall mode of IURC is the identification of different cooperation modes and different types of cooperation among organizations(Zhou, Wan&Gao, 2005). However, the current IURC in China lacks the strategic cooperation at the industrial and technical level. The cooperation goal is short term. With the speed of technological innovation and the increasing complexity of cooperation, This kind of "point to point" cooperation has been difficult to meet the needs of technological innovation. The form of IURC is becoming more and more diversified.

IURC is a unique and hybrid inter organizational relationship. It is beneficial to improve the effectiveness of technological innovation. Some existing researches had analyzed the choice of cooperation model. The evolution of IURC model is also discussed. However, the current study only discussed several dimensions of cooperation model selection and the evolution path of cooperation model, and had not yet discussed how to carry out governance in the light of specific cooperation models. This paper will argue that the cooperation model of IURC is to provide theoretical support for how to carry out cooperation. The governance of cooperation model is also an unavoidable problem for enterprises, universities and research institutes. This paper hopes to provide effective theoretical support for the follow-up research by studying the governance mechanism of IUR.

2. Literatures Reviewing

Along with the process of industrial revolution and university reform, the idea of IURC began to appear in America and "Silicon Valley miracle" has been created. Later, the developed countries, such as Germany, Britain, Japan and Finland all carried out the practice of IURC and formed a unique mode of IURC. The research mainly focused on IURC innovation, IURC R & D and so on.

In terms of IURC and its mode research, the study of the composition of biotechnology enterprises in America found that top university researchers participated in the technological innovation projects of the enterprises, thus indicating that enterprises and schools had begun to cooperate (Zucker, 1998). Through the study of the formation of regional industrial clusters in West Germany, it is considered that most of the technology intensive industries were closely related to universities and research institutes (Harhoff, 1999). The model of IURC is divided into six categories: general R&D funding, university's industrial partner program, R&D center, cooperative R&D, IURC development alliance, entrepreneurial compensation machine, science and technology park (Kogut, 1988). Types of

cooperation included formal contractual relations management, technology transfer offices, cooperative school running, and consultation and cooperation (Hall, 2000). Chinese scholars explored collaborative innovation theory, whose core was the knowledge value and believed that IUR, political and educational system as the main innovation and participated in value creation (Chen & Yang, 2012). One research argued that the cooperation model of IURC into three stages. According to the process of knowledge transformation between subjects, the paper put forward the theory model of knowledge flow in IURC innovation (Gu & Wei, 2012). Moreover, scholars have discussed the mode of IURC innovation from two dimensions of IUR organization, external drive and internal drive. Concerning the governance mechanism of Industry University Research Institute, some one analyzed how the industry university research institute and University Institute cooperate through trust and contract and the external restraint of the bilateral governance model from the perspective of social transaction (Jin-Song Huang, 2015).

3. Theoretical Deduction

In essence, the cooperation model is a kind of structure function model and reflects the relationship between IURC. As a kind of inter organizational cooperation relationship, IURC will be influenced by many factors, such as politics, economy and culture. As a concrete manifestation of the cooperative relationship in the practice of industry-university-research, the mode of IURC is bound to be affected by the above factors, so that the use of cooperation model has its specific scope of application. The nature of IURC model is determined by the following three factors: the organizational resources of universities or scientific research organizations, the length of cooperation agreements, and the degree of formalization of cooperative relations (Bonaccorsi & Piccaluga, 1994). Therefore, we can consider the stability of the IURC model from these three dimensions. The more the university organization or scientific research organization participates in the cooperation, the longer the cooperation agreement and the more formal cooperation relationship, the more stable the cooperation model is. Accordingly, the research institute cooperation model is divided into three types: loose cooperation, close cooperation and partnership cooperation. (As is shown in Table 1.) The ultimate goal of technological innovation between enterprises and universities and scientific research institutions is to learn new knowledge from universities and research institutes, thus developing new products to meet the changing market demands. On the other hand, industry-university-research is essentially social transaction. The particularity of this kind of transaction lies in the transaction. The purpose is to carry on the innovation activity, and to promote the bilateral transaction, not only can enhance the enterprise's innovation ability. It can also create social rents and increase social welfare. But because of adverse selection, moral hazard and delay, the market mechanism is inefficient in the process of University's technological achievements. It is difficult to determine a fair and reasonable price for technical products. Even though cooperation between production and research has developed, bounded rationality makes contracts incomplete. In the process of cooperation, many opportunistic behaviors are difficult to observe and confirm, and the third party intervention can not guarantee the smooth implementation of the contract. From the point of view of the transaction, both sides of the University and Research Institute select a governance model to coordinate and control each other's behavior in order to conclude the transaction. Based on the theory of social transaction, trust governance and contract governance based on institutional economics provide two alternative governance models for both sides.

Table 1. Industry-university-research cooperation model and governance mechanism

Cooperation model	Organization resources	Cooperative agreement time	Formalization of partnership	Cooperat-ive stability	Specific form of cooperation	Governance mechanism
loose cooperation	less	short	informal or formal personal relations	bad	short-term commissioned research or Technology transfer	relationship governance
close cooperation	many	long	formal agreement	good	project cooperation, Joint training of talents or co-construction laboratory	contract governance
partnership cooperation	more many	very long	highly formal partnership	very good	cooperative research Joint training of talents or co-construction laboratory	mixed governance

3.1 Loose Cooperation and Relationship Governance

When the original knowledge system is relatively weak without too much effort, enterprises in order to avoid the uncertainty in the process of technological innovation, the general choice in the development of technology has been mature in the back-end technology innovation cooperation. the relationship between enterprises and universities, scientific research institutions is more loose. A cooperative model based on formal or informal relationships between individuals is chosen such as technology transfer, entrusted research, etc. In this stage, the objectives of cooperation between enterprises and universities and scientific research institutions are generally short-term. Long-term strategic cooperation is not considered. Universities and research institutions are reluctant to invest too much resources. Industry-university-research cooperation mode is in poor stability. Once there is a risk incentive, the relationship between IURC will be suspended. Cooperation between each other is in the stage of running in. The parties concerned will conduct exploratory cooperation.

At this point, the cooperation between them is in the stage of running in, the two sides to explore, the core enterprises will adopt informal governance mechanism, to promote good relations of cooperation as the first, and gradually build confidence and promote cooperation in-depth. Informal governance mechanisms will be adopted to promote good relations of cooperation first, gradually build confidence and promote cooperation in depth.

3.2 Close Cooperation and Contract Governance

With the increasing number of cooperation between the two sides, on the basis of existing successful cooperation, enterprises have accumulated a certain amount of knowledge about Universities and scientific research institutions. It is easier to understand the new knowledge obtained from universities and scientific research institutions and make use of them

The ability to innovate outside knowledge. As part of the gains from the new knowledge gained, the desire for enterprise cooperation is increased and they will make efforts to promote bilateral relations. Enterprises and universities and research institutions are willing to invest more resources in cooperation. The time of cooperation between the two sides is growing longer and the relations between them are becoming more formalized. They may choose more research cooperation mode based on formal agreement and cooperation cycle in this stage, such as building laboratories and training talents. The two sides have the opportunity to conduct research and development activities at the same location, which provides more opportunities for cooperation between the two sides. The goal of cooperation between enterprises and universities and scientific research institutions has gradually shifted from focusing on short-term benefits to enterprise development strategies. The stability of industry-university-research cooperation is enhanced. At the same time, a formal governance

mechanism will be adopted, such as the form of contracts, to regulate cooperation projects such as technology transfer and cooperative R & D. On the one hand, the output such as skills, technologies and information can be priced to increase the output cost. On the other hand, the key technical skills are restrained by contract and effective knowledge protection is carried out. Preventing the loss of core technology and resources, resulting in the loss of unilateral core competence of cooperation. Meanwhile, strategy is used to protect the knowledge and reduce the free riding and opportunism behavior of enterprises, universities and research institutes .

3.3 Partnership Cooperation and Mixed Governance

With the extension of cooperation time and the deepening of cooperation, the frequency of communication has increased, the forms of cooperation have been diversified, and the original knowledge system of enterprises has accumulated more. As the level of effort continues to improve, we will be more willing to participate in IURC in the early stages of the technology cycle. When the degree of resource participation is improved, the high-level enterprises begin to participate in IURC, which makes IURC become a kind of strategic behavior of enterprises.

Accordingly, the organizational resources invested by universities and scientific research institutions are also increasing, and the cooperative relations between the two sides have become interdependent. The cooperation between the two sides has been extended for a long time, and the cooperative relation has been formalized, forming a cooperative partnership of the strategic alliance. The two sides will jointly carry out technical research, build laboratories and jointly train talents. In this stage, the stability of IURC is very high, and it is not easy to be affected by external risks and inducements. The mutual cooperation has a fairly good understanding, and their status and relationship are stable. They are accustomed to the established conventions. Contract and other normal forms are weakened. Trust and understanding is more important to maintain relations with each other. For the customary cooperative project, standardized contract governance has been adopted. For some of the new development cooperation projects or knotty problem are dealt by relationship governance.

4. Research Design

4.1 Case Study Method

This paper adopts the case study method to explain the mode and governance mechanism of IURC. Case studies are based on rich qualitative data, and describe and analyze a specific phenomenon in a realistic environment. Compared with other research methods, case studies can describe and understand the case in a systematic way. It can also control the cooperation model and the context of the situation, and then get a more comprehensive and holistic view. Single case is helpful to understand the dynamic complex mechanism hidden behind a specific phenomenon, and to observe and explore the vertical evolution mechanism of IURC.

4.2 Case Enterprise Selection

The choice of case enterprises must satisfy the typicality and representativeness of case studies, and at the same time satisfy the consistency of research questions and situations. This study identified the following selection criteria: Enterprises are in the leading position in the same industry; Enterprises have rich experience in the innovation of IURC; Enterprise related early research data is rich, and it is beneficial to long-term vertical research. Based on the above criteria, this study selected Hubei black cyclones company as the case study enterprise. First of all, the Black Cyclones company is the largest and most professional diamond circular saw production and research enterprise in Asia. Secondly, the Black Cyclones has established a long-term cooperative relations with Steel Research Institute, Three Gorges University, Beijing Science and Technology University, Huazhong Science and Technology University and other universities and research institutes. It actively carried out scientific research and development project cooperation. Finally, Black cyclones company is a research and production

demonstration enterprise selected by China Association for production, research and promotion. It has a wealth of research experience and research materials, and is conducive to long-term follow-up research.

4.3 Case Overview

The Black Cyclones company is headquartered in Hubei Yichang with the total assets of ¥500 million, and have two subsidiaries located in Laiwu and Thailand. It cooperated with China Three Gorges University to study the stress distribution and control measures of cemented carbide circular saw blades. Through theoretical analysis and practice, the hard alloy saw blade stress distribution was more scientific and standardized, stress adjustment mode was more reasonable and product quality of the hard alloy saw blade was improved.

The Black Cyclones company was in cooperation with Beijing Science and Technology University to set up advanced saw manufacturing technology research and development center and made full use of the university's "advantage subject innovation platform" and its other professional academic advantage in metallurgy, materials, machinery. The two units build information exchange platform and technology cooperation platform to further enhance the quality and speed of transformation of both science, technology development and scientific, technological achievements through scientific and technological cooperation with their respective advantages, talent advantage, information advantage and industrial advantage. The black Cyclones did the experiment and shared facilities with Huazhong Science and Technology University's National Engineering Research Center in laser cutting, carving, welding, heat treatment and so on. The Black Cyclones carried out "diamond frame saw blade research and industrialization" project with Crystal Day Diamond Industry Co., Ltd. They realized the import of alternative products, promoted the development and progress of the whole building materials industry, and improved the competitiveness of this kind of domestic products in the international market through the transformation and industrialization of scientific and technological achievements.

4.4 Analysis of Cooperation Model and Governance Mechanism

According to the different modes of cooperation with partners, whether built alliance or cooperation network, whether the main organization form and operation mechanism of the alliance or cooperation between the parties have formed a more perfect and effective cooperation mechanism, coordination mechanism, interest distribution mechanism, information sharing and personnel training mechanism, cooperation mode with what governance mechanism, these are the kind of cooperation has been follow-up questions.

The Black Cyclones has set up an innovative system which is market-oriented, enterprises as the main body and institutions of higher learning as the support of innovation through IURC. The Black Cyclones and its partners have gone through the cooperation from scattered cooperation to close cooperation throughout the process of IURC. The early intention of cooperation was mainly due to some leaders of the Black Cyclones company, who had experienced study or training, and maintained good personal relations with these universities and research institutions. As a result, the pre-cooperation type is technology transferring or commissioned research project. For example, the stability of saw matrix steel has been investigated by China Three Gorges University. Personal relationships are the key link to maintain cooperation.

With the remarkable results achieved in the early stage of cooperation, the Black Cyclones gradually strengthened its cooperation with scientific research institutions and began to work together to overcome technical difficulties. The Black Cyclones designated staff to study in universities. Colleges sent graduates to practice and work in the Black Cyclones company. At this time, the cooperation project adopted the method of signing agreement to restrict the behavior of both sides.

At present, the form of cooperation has diversified. The content of cooperation also permeates the fields of enterprises, universities and research institutions. The partners together overcome problems, realize the innovation of new technology, new technology, new products, form the core

competitiveness of the industry through the formation of alliances, building the industrial chain collaborative innovation platform, the establishment of common laboratory technology and other related industries. IURC is conducive to promoting significant technological breakthroughs in related industries and will promote the integration and development of the industry chain, and make it bigger and stronger.

5. Discussion

The case reflected the different stages of IURC, and corresponded to different cooperation models and cooperative governance mechanisms. In the initial stage, the loosely cooperative model relied on the governance mechanism of personal relationship. The trust between organizations was weak. The cooperative relationship was private. The form of cooperation was relatively simple. With the strengthening and deepening of cooperation, the cooperation model become tight and governance mechanisms began to be normalized. Contractual governance was adopted. Cooperation was strengthened through contracts, and the content of cooperation become more broad. Further more, the forms of cooperation are diversified, the content of cooperation was more in-depth. The cooperative mode was changed into partnership type, and the governance mechanism was changed from contractual governance to inter-organizational-relationship governance and contract combination. The practice and research of the cooperation model were quite mature, but the cooperative governance mechanism was rarely involved. This point is similar with the previous research from calculation-based trust, knowledge-based trust, to identification-based trust and also as point-to-point, two-way interactive cooperation and symbiosis mode conversion network cooperation (Camen, Gottfridsson & Rundh, 2011). Thus it is an urgent problem to think about how to govern in the actual operation of the IURC. Better governance mechanism can has a positive effect on trust communication mechanism, interest distribution mechanism, incentive mechanism, resource sharing mechanism and promote the cooperation operation more smoothly, more fruitful.

6. Conclusion and Recommendation

Along with the growth process of new IURC, the cooperation mode among multi subject is from loose cooperation to close cooperation, and then to partnership cooperation. Governance relations from part cooperation based on fragmented trust to rely on formal contract cooperation, and then to the long-term cooperation based on contract and trust. This shows that there exists cooperation mode and governance mechanism which can form three typical models of IURC, which match each other and develop step by step. However, the common case study and investigation of mutual authentication show that the rate of technological upgrading is very different in different industries, and the internal enterprise genes and cultural characteristics are different. It is difficult to maintain a strict matching relationship with the IURC model and the governance mechanism, and the "dislocation" and "offside" phenomena occur frequently between the cooperation model and the governance mechanism. In the in-depth investigation of case enterprise, it was found that from cognitive trust to emotional trust. The important condition is the recognition of new ventures' culture and values. The non-enterprise members who participated in IURC can only maintain the identity of new ventures by understanding and accepting the enterprise values, holding the approval attitude to the enterprise development strategy and the internal organizational culture of the enterprise. If there exist "different, do not plan", cooperative members will part company each going his own way sooner or later and cooperation performance will not be guaranteed (Wang, Li & Chen, 2006).

Some new topics are extended under this background in terms of educational cooperation: how to maintain a harmonious relationship between governance mechanism and cooperation model in the process of IURC; what factors influence the matching between the governance mechanism of multi subject and the mode of IURC. The internal influence mechanism is still the "black box" in theory. The core of these extensions lies in "dynamic", which embodies the dynamics of the cooperative

relationship and the dynamics of the cooperation between research institute governance mechanism and cooperation model whether in education or in technological innovation.

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